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The taxonomy and distribution of some calanoid copepods in South African east coast estuaries

by

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SYNOPSIS

Two new species of calanoid copepods are described, *Diaixis centrura* and *Centropages natalensis*. The euryhaline *Bestiola similis* is recorded from South African estuaries for the first time, and some notes on the taxonomy and distribution of two common species, *Pseudodiaptomus hessei* and *P. stuhlmanni*, are given. A new distribution record for *Acartia (Paracartia) africana* on the east coast is also noted.

INTRODUCTION

The species included in this paper were taken from plankton samples collected from estuaries along the Natal and Eastern Cape coasts, from the Kosi estuary in the north, to the Swartkops estuary in the south. The plankton sampling was part of a national marine pollution survey conducted along the whole South African coast by the Council for Scientific and Industrial Research. All samples were taken in a sled-mounted net with a D-shaped mouth of 630 cm^2 area. This net is mounted on the sled with the straight edge of the D parallel to, and about 2 cm above, the ground. The net was hauled 50 m across the bed of the estuary at each station, theoretically filtering 3,15 m^3 of water per sample through mesh of 200 μ aperture. In all figures in this paper, measurements are in microns (10^{-3} mm), represented by bar scales next to the drawings.

DESCRIPTION OF MATERIAL

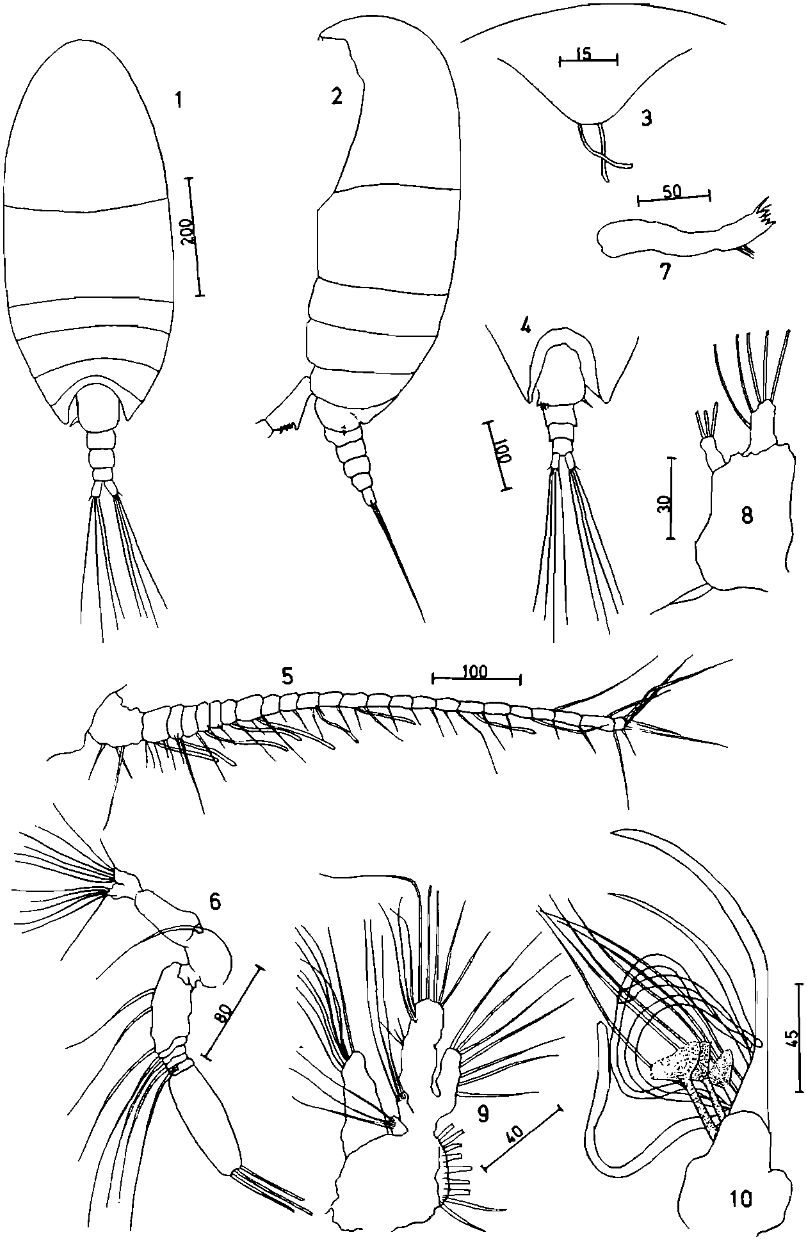
Family Diaixidae

Diaixis centrura sp. n. Figs 1–17, Plate 1

Type specimens: Holotype female (SAM–A16885), allotype male (SAM–A16886) and paratypes, 10 ♀ 10 ♂ (SAM–A16887), Umzimkulu estuary (30°44′S:30°27′E), Natal coast, A. D. Connell, August 1974. Deposited in the South African Museum, Cape Town.

Description

Female: Total length 0,76–0,84 mm. All five thoracic segments separate (Figs 1–2). Cephalothorax more than three times length of abdomen. Rostrum simple, (Fig. 3), with a pair of thread-like filaments (Fig. 3, Plate 1a). Posterolateral corners of cephalothorax nearly symmetrical (Figs 1, 4, Plate 1b), rounded in lateral view (Fig. 2, Plate 1c). Abdomen four-segmented. Genital segment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Figs 1–10. *Diaixis centrura* sp. n. Female. 1. Dorsal view. 2. Lateral view. 3. Rostrum. 4. Abdomen and fifth thoracic segment, ventral view. 5. Antennule. 6. Antenna. 7. Mandible. 8. Mandibular palp. 9. Maxillule. 10. Maxilla.

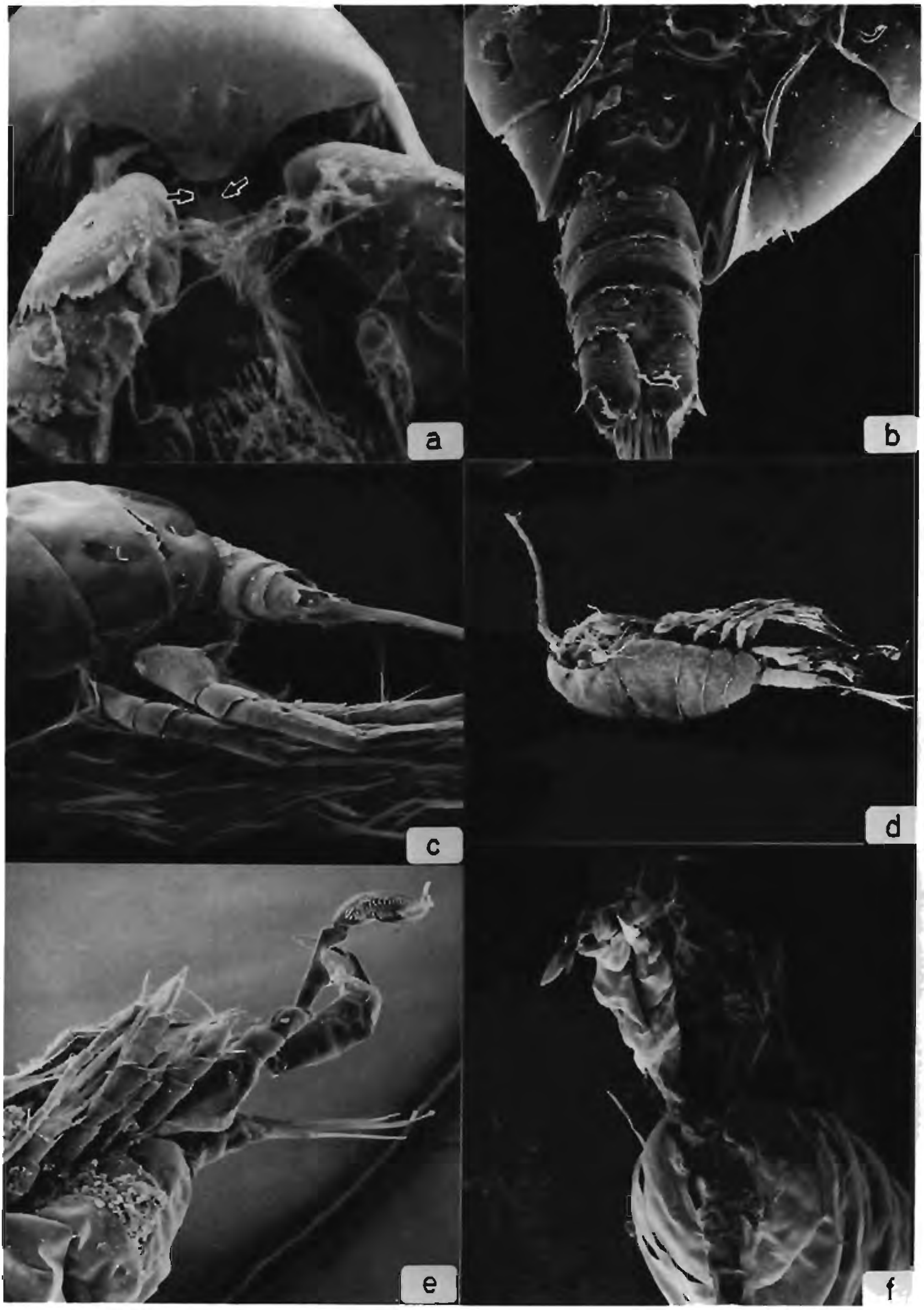
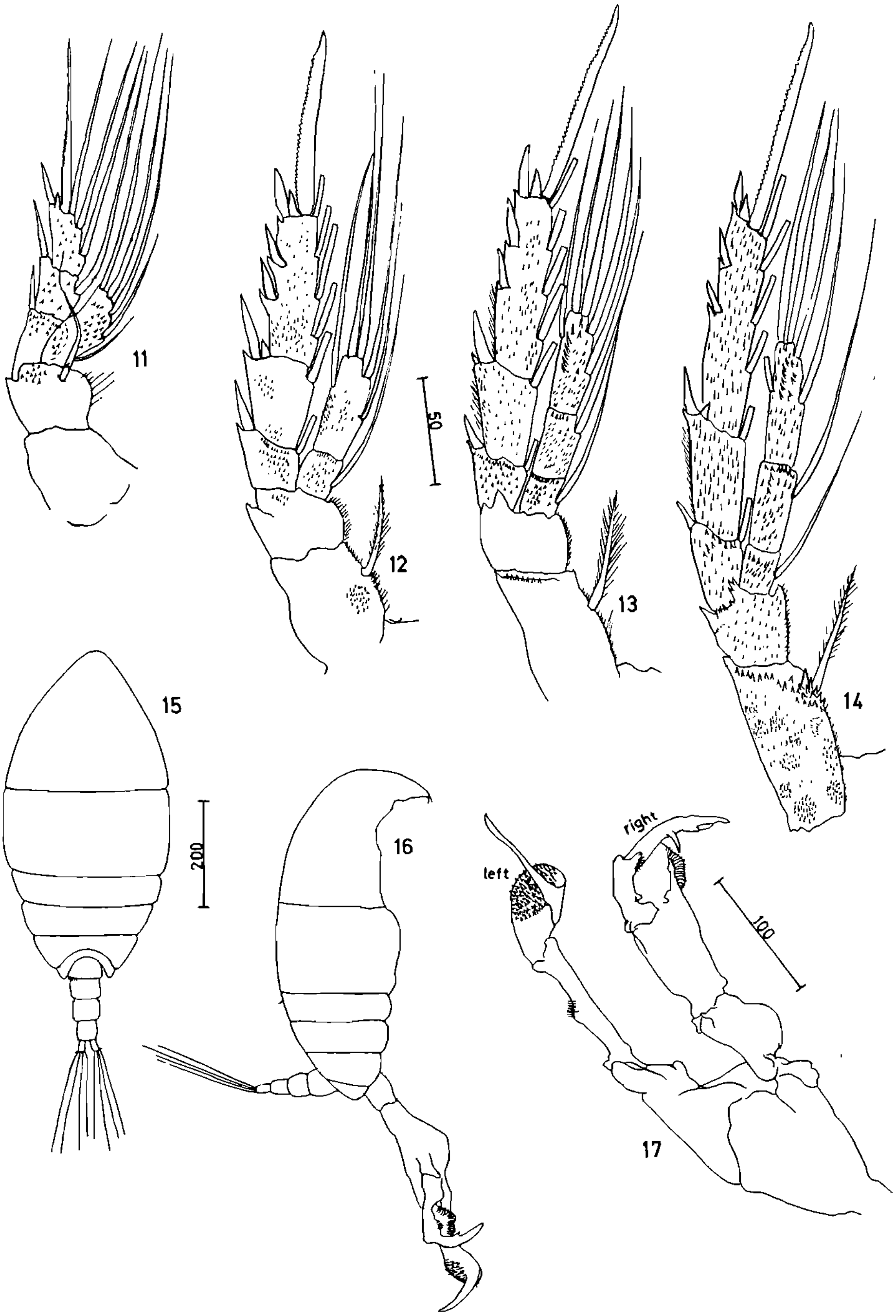


Plate 1. *Diaixis centrura* sp. n. Scanning electron microscope photographs. a. View of a slightly incurved rostrum, showing the rostral filaments (arrowed). b. Female, ventral view of thorax and abdomen. c. Female, lateral view of thorax and abdomen, showing well-developed spine on basipod of left leg 4. d. Male in lateral view. e. Male. View of orientation of leg 5 in right lateral view. f. Male. Posterior view of leg 5, showing apparent development of right side only.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Figs 11–17. *Diaixis centrura* sp. n. 11–14. Female. 11. Leg 1, posterior view. 12. Leg 2, posterior view. 13. Leg 3, posterior view. 14. Leg 4, posterior view. 15–17. Male. 15. Dorsal view. 16. Lateral view. 17. Leg 5, anterior view.

simple, with a spine left laterally (Figs 1, 4) and some small spines on right ventral posterior edge. Plate 1b shows ventral pattern of genital segment. Relative lengths of abdominal segments 1–4 and furca (as percentages of the total length) as follows: 38 12,2 15,5 18,5 16,3.

Antennules reach almost to end of thorax, and consist of 24 segments. As noted by Grice & Hulsemann (1970) in *Diaixis* segments 8 and 9 fused (Fig. 5). Endopod of antenna about half length of exopod (Fig. 6).

Mandible (Fig. 7) and palp (Fig. 8) similar to *D. asymmetrica* (Grice & Hulsemann, 1970). Mandible bears a small cluster of hairs subdistally (Fig. 7). Exopod of maxillule without sensory setae (Fig. 9). Distal end of maxilla with three flower-like and four worm-like sensory setae (Fig. 10). Maxilliped similar to *D. asymmetrica* but with only two worm-like sensory setae on basal segment.

First four pairs of legs typical of genus, with setation as shown (Figs 11–14). All legs have posterior surface of segments covered with fine scale-like setae. First basal segment of left leg 4 bears set of teeth on inner posterior edge, largest easily visible in lateral view (Plate 1c). P5 absent.

Male: Total length 0,69–0,78 mm. In dorsal view (Fig. 15) head is more pointed, but in lateral view is similar to female (Fig. 16). Posterolateral corners of cephalothorax less protruded than in female; in lateral view they are not bulbous. Cephalothorax more than three times length of abdomen. Abdomen four-segmented. First abdominal segment short, with hair-like spines on its left and right posterior ventral edges. Some hairs on the left lateral edge exceed half the length of the second abdominal segment. Relative length of abdominal segments 1–4 and furca as follows: 18,5 22,5 21,3 21,7 16,0.

Rostrum as in female. Antennules reach to second abdominal segment and are similar to female except that distal segments are more elongated. Antennae and mouthparts as in female, except maxilliped lacks the two worm-like sensory setae on the basal segment.

First four pairs of legs as in female except covering of fine setae on posterior surface of segments reduced or absent, and large spine on first basal segment of left P4 absent. Fifth legs grossly modified (see discussion) one ramus developed as a grasping organ, other terminating in a bristled pad and seta (Fig. 17, Plate 1d–f).

Occurrence: The species has so far only been collected in the Umzimkulu estuary. Numbers collected increased toward the mouth of the estuary. Sampling was confined to the lower two kilometres of the estuary, due to shallow sandbars resulting from excessive siltation. Salinities ranged from 29,0 to 32,6‰ on the bottom of the estuary where the sled-net operated, in depths ranging from 1 to 3 metres. In an estuary where our samples revealed a relatively sparse zooplankton, the 636 specimens of *D. centrura* collected constituted about 7 per cent of the animals in the samples.

Discussion: The diagnosis of the genus *Diaixis* (Sars, 1902) states that head and thorax are fused, but *D. asymmetrica* Grice & Hulsemann, 1970, *D. tridentata* Andronov, 1974 and *D. centrura* show the head and first thoracic segment separate. In addition to this *D. asymmetrica* is stated to have a divided rostrum, while Sars defined the genus as having a simple rostrum without filaments. *D. centrura* has a pair of thin filaments hanging down from the underside of a simple rostrum. In this respect it closely resembles *D. durani* Corral Estrada, 1972 and also to some extent *D. tridentata*. The female can be separated from the five known members of the genus previously described, by the shape of the postero-lateral corners of the cephalothorax and the presence of a large spine on the left side of the genital segment, while the male fifth leg is at once distinctive.

The male fifth leg is grossly modified and led to some confusion when describing this species. The position of attachment to the body (Plate 1f) suggests that the right leg only is developed, the left being completely reduced. The question of which constitutes the left and right ramus of this leg is also confusing. Both Sars (1902) and Corral Estrada (1972) described the grasping organ as being the left ramus, but on the specimen used in drawing Fig. 17 this was on the right, as shown also in Plate 1f. However, Plate 1d and 1e show specimens with this ramus positioned on the left of the body. An examination of a number of specimens in formalin showed both cases, suggesting that the entire leg can pivot on its base.

Family Centropagidae

Centropages natalensis sp. n. Figs 18–34

Type specimens: Holotype female (SAM–A16888), allotype male SAM–A16889) and paratypes 10 ♀ 10 ♂ (SAM–A16890), Richards Bay (28°49'S:32°10'E) Natal coast 140 km north of Durban, A. D. Connell, October 1975. Deposited in the South African Museum, Cape Town.

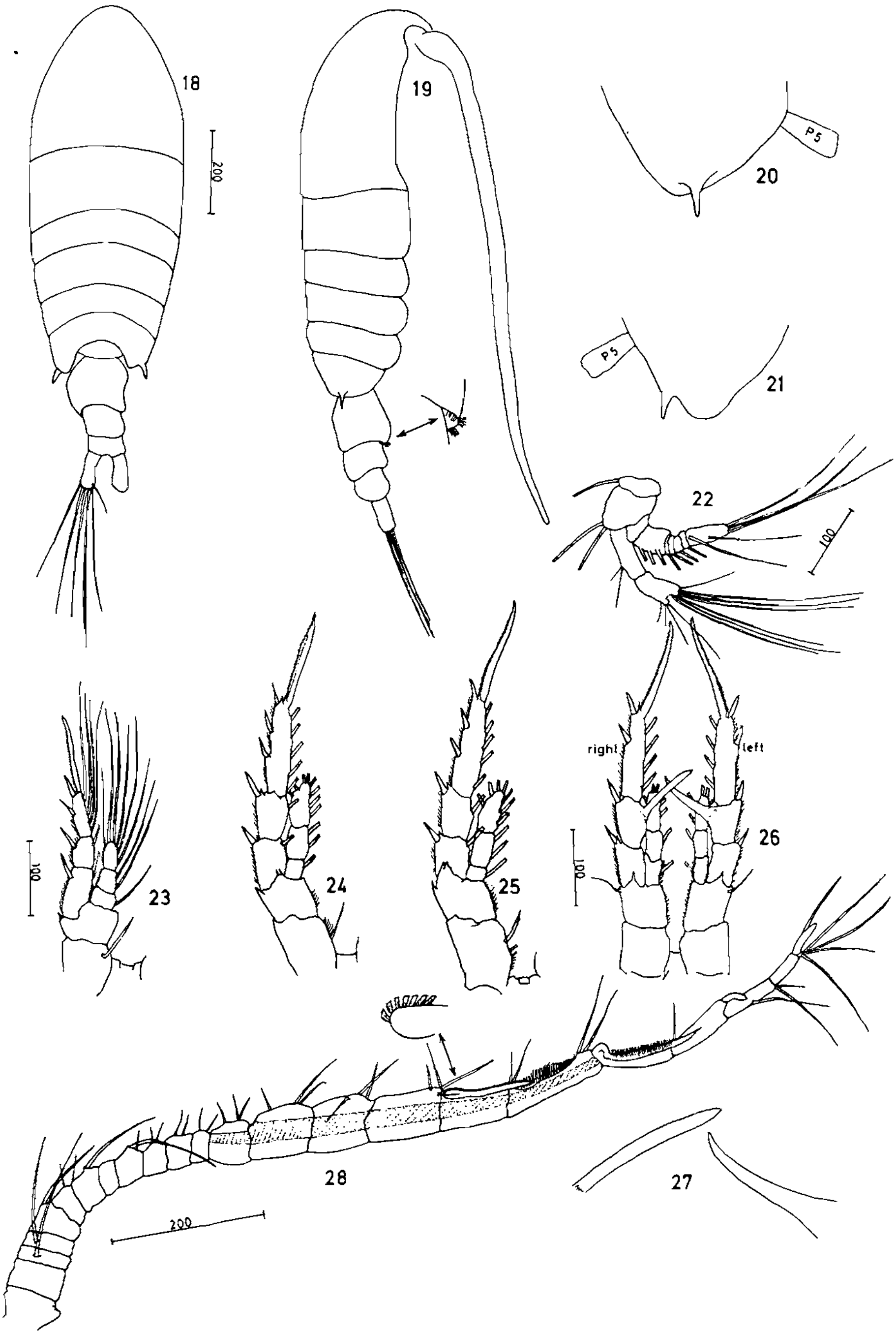
Description

Female: Total length 1,14–1,25 mm. All five thoracic segments separate. Postero-lateral corners of fifth thoracic segment extended, asymmetrical, left slightly longer (Fig. 18). Both sides terminate in a spine, right spine subterminal (Fig. 20) left spine more ventral (Fig. 21). Cephalothorax 2,5 times abdomen length. Abdomen 3-segmented. Genital segment distinctly curved in dorsal view (Fig. 18) with only one group of spines, on posterior ventral edge (Fig. 19).

Antennule extends past tip of furca by last two segments. No spines present on any segments of antennule. Antenna (Fig. 22) and mouthparts normal for genus.

Legs show structure and setal arrangement typical of genus, without any characteristic features. Number of setae on endopod 3 increases from 6 on P1 (Fig. 23) to 8 on P2 (Fig. 24), but reduced to 7 on P4 (Fig. 25). Serration of terminal exopod spines is fine. On fifth pair of legs, large spine on inner edge of left exopod segment 2 typical, being down-turned and without serration (Figs 26–27). On the right leg, equivalent spine developed into a finely serrated up-curved blade (Fig. 27).

Cephalothorax usually coloured pink to reddish dorsally, either confined as a central blotch at point of junction of head and thorax, or continuing down centre of thorax as a pink tint, often extending to genital and second abdominal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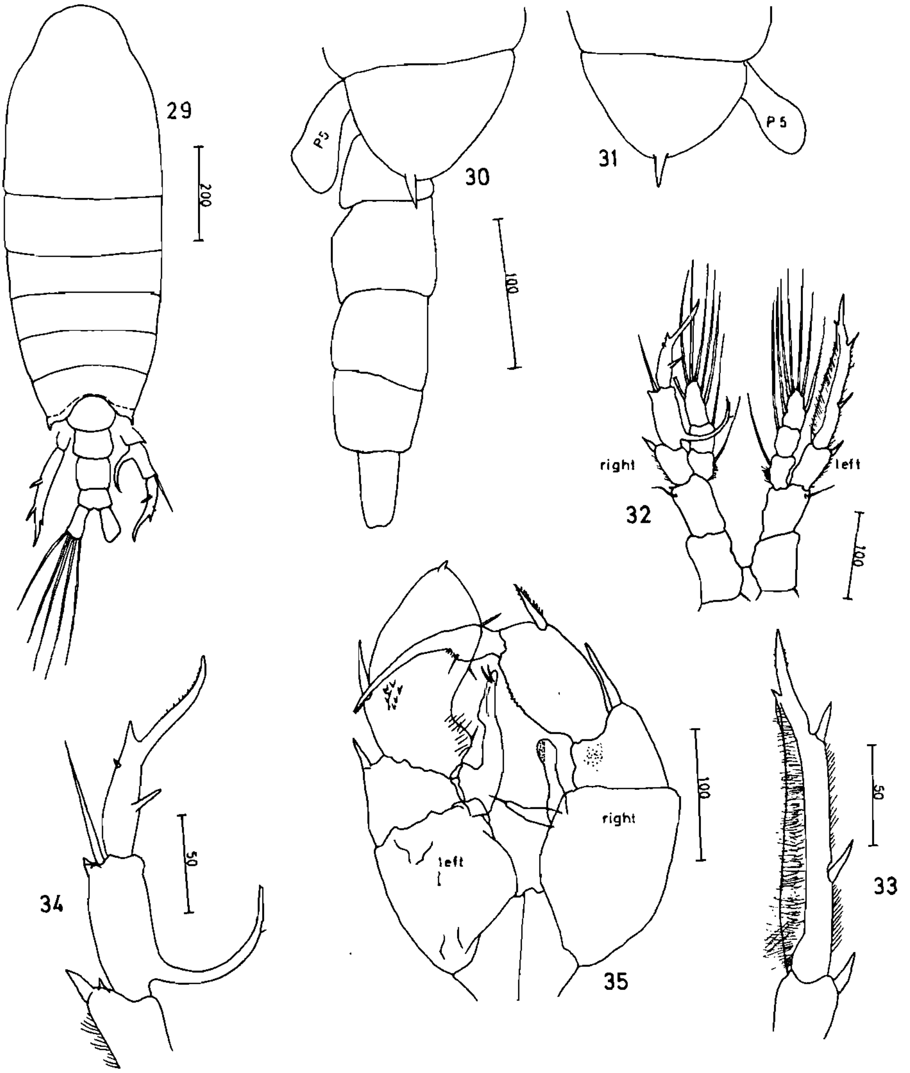
Figs 18–28. *Centropages natalensis* sp. n. 18–27. Female. 18. Dorsal view. 19. Lateral view. 20. Fifth thoracic segment and spine, right side, lateral view. 21. Fifth thoracic segment and spine, left side, lateral view. 22. Antenna. 23. Leg 1. 24. Leg 3. 25. Leg 4. 26. Leg 5, posterior view. 27. Detail of blades on female Leg 5. 28. Male geniculate antennule.

segment. This colouring, which covers about a quarter of width of thorax in dorsal view, makes specimens easy to spot in a sample.

Male: Total length 1,12–1,22 mm. Although slightly smaller, male very similar to female. Posterolateral corners of fifth thoracic segment less extended, more or less symmetrical in dorsal view (Fig. 29). Spine situated terminally on each side (Figs 30–31). Cephalothorax 2,7 times length of abdomen. Abdomen four-segmented, without spines.



Figs 29–35. 29–34. *Centropages natalensis* sp. n. Male. 29. Dorsal view. 30. Abdomen and fifth thoracic segment, left lateral view. 31. Fifth thoracic segment, right lateral view. 32. Leg 5, posterior view. 33. Leg 5, Detail Left exopod terminal segment. 34. Leg 5, Detail Right exopod segments 2 and 3. 35. *Pseudodiaptomus stuhlmanni* (Poppe & Mrázek) Male Leg 5, anterior view.

Geniculate antennule bears spines on segments 18, 21, 23 and 25 (Fig. 28). On segments 18 and 21 spine is an extension of serrated plate which runs whole length of segment. Segment numbering according to Wellershaus (1970).

Mouthparts and swimming legs 1 to 4 as in female. Fifth leg (Fig. 32) left exopod terminal segment has hair-lined groove running up inner edge (Fig. 33). On right leg spine on inner edge of exopod segment 2 slender and curved, with pointed tip and small subterminal seta. Terminal blade on exopod 3 short and only slightly curved, without serration (Fig. 34), but lined by 8 or 10 fine setae.

Occurrence: The species was found in limited numbers in the Mtentu estuary, in samples collected by the author during 1971 and 1972. This estuary is situated 32 km south-west of Port Edward on the Transkei coast (31°15′S:30°3′E). More recently, during sampling in Richards Bay, specimens were collected in greater numbers during November 1974, October 1975, and June and November 1976. Salinities in Richards Bay samples containing *C. natalensis* ranged from 17,0 to 34,5‰. Recently (22 October 1975) specimens were also collected in the open sea, at 29°11′S : 31°56′E, a point 18 nautical miles ESE of the Amatikulu river mouth, in water of 45 m depth (temperature 20,7–21,4°C, salinity 35,3‰). The specimens, two males and four females, were taken in a WP2 net hauled vertically from 35 m to the surface. The sample was part of a series collected for Sea Fisheries Branch by Mr P. C. N. van der Byl.

Discussion: *C. natalensis* is closely related to *C. alcocki* Sewell. The female is easily distinguished from *C. alcocki*, however, by the lack of patches of small spines on the fifth thoracic segment and genital segment (Wellershaus, 1970, figs 7 and 8), and the asymmetry of the genital segment when viewed from above. The pink colouring dorsally in fresh specimens and the different shape of the inner spine on the right P5 exopod 2 are other distinguishing features. There are also no spines on the antennules of the female, to compare with those described by Wellershaus on segments Aa 9 and Aa 13 of *C. alcocki*.

Males have the characteristic 'knife' terminally on the geniculate antennule, as figured for *C. alcocki* by Wellershaus (1970) but lack spines on segments 11, 12 and 13 of the antennule. In addition to the presence of pink colouring dorsally on fresh adult specimens, males can also be separated from *C. alcocki* males by the length/width and length/spine length values for the exopod 2 segment and its inner spine on the right P5. These are as follows:

	C. alcocki	*C. natalensis*
$\frac{\text{Length}}{\text{Width}}$ of segment 2 exopod P5	*ca.* 1,0	>2,0
$\frac{\text{Length of spine}}{\text{Length of segment}}$	>2,0	*ca.* 1,2

The length and lack of serration on the terminal spine of the right P5 exopod 3 and the presence of a hair-lined groove on the inner edge of the terminal segment of exopod 2–3 of the left P5, are also distinctive.

Family Paracalanidae

Bestiola similis (Sewell, 1914)

Acrocalanus similis Sewell, 1914: 211, pl. 17 (figs 3–5)
Bestiola similis Andranov, 1972: 290

At the start of the development of Richards Bay as a harbour complex in late 1974, I had the opportunity of collecting zooplankton samples in the southern section of the bay. At the time the berm wall was being built across the bay, but had not yet been completed. These samples showed *B. similis* to be by far the most common member of the zooplankton. Subsequent to completion of the berm wall, construction of the new mouth for the southern section of the bay resulted in greater tidal exchange. However, canalisation of the lower reaches of the Mhlatuzi river followed by two heavy floods caused unprecedented silting of the upper estuary, resulting in a greatly reduced zooplankton population in the estuary. Eleven samples collected in November 1974 contained a mean of 38 000 *B. similis* each (range 18 300–77 500). This amounted to a mean of about 12 000 per cubic metre. Sixteen similar samples in October 1975 showed a mean of 2 403 *B. similis* per sample (range 10–8 980), and eleven samples in June 1976 had a mean of 215 *B. similis* per sample. Total numbers of all species in the zooplankton showed a similar drop in numbers over the same period. The extensive silting and enlarging mouth resulted in increased bay water exchange rate, and this was probably the largest contributing factor to the greatly reduced zooplankton population in the bay. Exchange rate which was very low in late 1974 had increased to a spring tide exchange of 33–50% per tide cycle by October 1975, and about 80% by mid-1976 (J. Hemens, pers. comm.). Salinity of samples containing *B. similis* ranged from 17,0 to 34,9‰.

B. similis is also important in the harbour area of Richards Bay, where numbers of up to 15 000 per cubic metre were encountered during sampling in November 1976, at salinities of 34,7 to 35,4‰.

In addition to the above, *B. similis* has been recorded in small numbers, from the Umgababa estuary (30 km south of Durban, February 1977), the Bashee estuary, Transkei (June 1975) and the Buffalo estuary, East London (April 1977). The species is thus widespread in estuaries on the east coast of South Africa.

Specimens from Richards Bay were slightly larger than those collected from Cochin Backwater by Wellershaus (1969). Females ranged from 0,84 to 0,94 mm, and males from 0,86 to 0,96 mm. Sewell's (1914) drawing of the female P3 shows only one seta on the inner edge of endopod segment 2, where there are two in specimens from Richards Bay. However, Sewell's drawing of the P4 shows two setae on this segment, suggesting an omission from his drawing of the P3.

The previously known range of *B. similis* was the Gulf of Mannar (Sewell, 1914) and the Cochin Backwater (Wellershaus, 1970). It was not reported by Gurney (1926) from the Gulf of Suez, and as far as I am aware this is the first time it has been recognised from South African waters.

Family Pseudodiaptomidae

Pseudodiaptomus hessei (Mrázek, 1894)

Schmackeria hessei Mrázek, 1894: 1, Figs 1–3

and

Pseudodiaptomus stuhlmanni (Poppe & Mrázek, 1895) Fig. 35

Schmackeria stuhlmanni Poppe & Mrázek, 1895: 3–7 TAFL 1, (figs 1–9)
Pseudodiaptomus charteri Grindley, 1963: 381–384, figs 4a–j

These two common species can easily be identified from Grindley's (1963) drawings; *P. charteri* is a synonym of *P. stuhlmanni* (Grindley, in press). However, Grindley's (1963) drawing of the male P5 of *P. stuhlmanni* is incomplete, since there is a stout club-like ramus with a distal granular patch, adjacent to the endopod of the right leg. The endopod itself is a small tapered structure with a terminal seta (Fig. 35).

Females of the two species are easily distinguished when carrying eggs, as the egg-sac of *P. stuhlmanni* is always more loosely packed, and more oval in shape, as well as being larger than in *P. hessei*. In *P. stuhlmanni* the egg-sac often extends past the tip of the furcal setae. The broad blade-like third furcal seta of *P. hessei* females is also distinctive (Grindley, 1963).

During the present series of samples, *P. hessei* was collected in all estuaries, from the Swartkops in the south (Port Elizabeth) to Richards Bay and the Kosi Lakes in the north. In Richards Bay samples were always dominated by *P. stuhlmanni*, but in the Kosi Lakes both species were present in fair numbers. *P. hessei* has recently also been collected in Lake Mzingazi; the present freshwater supply to Richards Bay (B. K. Fowles, pers. comm.).

The southern limit of the known range of *P. stuhlmanni* is extended by the present study. Previously known from Quelimane in northern Mozambique (Poppe & Mrázek, 1895) and St Lucia and Richards Bay (Grindley, 1963), specimens have recently been collected in the Umgababa estuary where it at times dominates *P. hessei*, although both are usually dominated by *Acartia natalensis* in this blind estuary. Further south, *P. stuhlmanni* has been collected in the Umzimvubu (Port St Johns, Transkei) and Mngazana estuaries (August 1977). In the Umzimvubu several thousand were counted in some samples, but in the same samples *P. hessei* was present in hundreds of thousands.

Family Acartiidae

Acartia (Paracartia) africana Steuer, 1915

Acartia assymetrica Tanaka, 1964

Recently, Connell & Grindley (1974) described *A. (Paracartia) longipatella* as the only member of the subgenus in the Indian Ocean. *A. (P.) africana* has, however, now been found in plankton samples from the present series, in the Swartkops (February 1975), Buffalo (April 1977) and Bashee (December 1975) estuaries. The specimens were always collected in samples taken near the mouth of the estuary, in marine waters moving up the estuary on the incoming tide. The previously published range of this species was off the coast of South West Africa (Unterüberbacher, 1964) and as far south as the 'Bay of Cape Town' (Tanaka, 1964).

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REFERENCES

Andronov, V. N. 1972. *Bestiola* Gen. N. (Copepoda, Paracalanidae) *Zoologicheskii Zhurnal* **51**: 290–292.

——— 1974. New species of Diaixidae and Stephidae (Copepoda) from the northern regions of the Indian Ocean. *Zoologicheskii Zhurnal* **53**: 460–464.

Connell, A. D. & Grindley, J. R. 1974. Two new species of *Acartia* (Copepoda, Calanoida) from South African estuaries. *Ann. S. Afr. Mus.* **65**: 89–97.

Corral Estrada, J. 1972. *Diaixis durani*, neuva especie de Copépoda Calanoide procedente de la Ría de Arosa, NW. de España. *Bol. Inst. Esp. Ocean.* **150**: 51–59.

Grice, G. D. & Hulsemann, K. 1970. New species of bottom living calanoid copepods collected in deep water by the D.S.R.V. Alvin. *Bull. Mus. Comp. Zool.* **139**: 185–230.

Grindley, J. R. 1963. The Pseudodiaptomidae (Copepoda; Calanoida) of Southern African waters, including a new species, *Pseudodiaptomus charteri*. *Ann. S. Afr. Mus.* **46**: 373–391.

——— In press. Notes on species of *Pseudodiaptomus* (Copepoda: Calanoida) from South Africa.

Gurney, R. 1926. Report on the crustacea: Copepoda and Cladocera of the Plankton. Zoological Results of the Cambridge Expedition to the Suez Canal, 1924. *Trans. Zool. Soc. London.* **22**: 139–172.

Poppe, S. A. Mrázek, A. 1895. Die von Herrn Dr F. Stuhlmann auf Zanzibar und dem gegenüberliegenden Festlande gesammelten Süsswasser-Copepoden. *Mitt nat. Mus. Hamburg.* **12**: 123–134.

Sars, G. O. 1902. *An account of the Crustacea of Norway.* IV Copepoda Calanoida. pts V and VI. pp 49–72.

Sewell, R. B. S. 1912. Notes on the surface-living Copepoda of the Bay of Bengal I and II. *Rec. Indian Mus.* **7**: 313–382.

——— 1914. Notes on the surface Copepoda of the Gulf of Mannar. *Spolia zeylan.* **9**: 191–263.

Steuer, A. 1915. Revision der Gattung *Acartia* Dana. *Zool. Anz.* **45**: 392–397.

Tanaka, O. 1964. Two small collections of copepods from the Antarctic. *Scient. Rep. Jap. Antarct. Res. Exped.* (E) **22**: 1–20.

Unterüberbacher, H. K. 1964. Zooplankton studies in waters off Walvis Bay with special reference to the Copepoda. *Investl. Rep. mar. Res. Lab. S.W. Afr.* **11**: 3–42.

Wellershaus, S. 1969. On the taxonomy of planktonic Copepoda in the Cochin Backwater (a South Indian estuary). *Veröff. Inst. Meeresforsch. Bremerh.* **11**: 245–286.

——— 1970. On the taxonomy of some Copepoda in Cochin Backwater. *Veröff. Inst. Meeresforsch. Bremerh.* **12**: 463–490.

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